Landscape Evolution in Cebu, Central Philippines: The Impact of Sea Level, Social History, and Tectonism on Archaeological Landscapes

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INTRODUCTION

Over seventy years ago, H. Otley Beyer (1947) sketched the archaeology of the Philippines. Occasional dramatic discoveries have been made since then, but there continue to be enormous gaps in settlement history, and some periods have gone entirely missing. The volume of archaeological investigations in the Philippines, especially in the last decade, has been extensive and steady, although sites or terrains with long, continuous histories in Philippine landscapes have so far eluded discovery. This has frustrated chronology building in the archipelago (Table 1). Beyer's vague and derivative chronology, divided into the Palaeolithic, Neolithic, Iron or Metal Age, Porcelain Age, and Spanish periods, thus remains the best heuristic fit to the data.

Physical changes in the landscape stemming from tectonism, sea level changes, and the aggradation and degradation of ground surfaces both destroy and preserve fragments of the human history of the landscape. Cultural choices and human history itself impact the landscape. Changes in subsistence patterns and foreign contact introduce new practices, with new effects on landscape formation and transformation. This article summarizes an effort to read the Visayan landscape in hopes of learning why archaeological landscapes from throughout more than 60,000 years of settlement in the Philippines have been so elusive (Fig. 1). Fred Eggan, the American anthropologist who sponsored and supported Philippines studies for several decades in the mid-twentieth century, recommended to his students to find a home research terrain that they could return to from time to time, always seeking lessons and learning from increasing familiarity. Following that advice, this work focuses on the central portion of the island of Cebu on the eastern slope of the cordillera near the municipality of Carcar.

High population density and intensive land use over several centuries have formed and transformed landscapes in the Philippines to the extent that site discovery is occulted. Except for those of the past half millennia, sites and landforms are either

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Table 1. Heuristic Archaeological Chronology for the Philippines

BEYER 1947	SOLHEIM 2002	TENAZAS 1977	JUNKER 1999	PERIOD	ATTRIBUTES
Palaeolithic	Archaic			to 5000 B.C.	lithic tools
	Early Incipient Filipino			5000 to 3000 B.C.	preliminary exploration of Southeast Asian maritime culture
Neolithic	Middle Incipient Filipino			3000 to 2000 B.C.	ceramics, expansion of settlement
	Late Incipient Filipino			2000 to 1000 B.C.	red-slipped and impressed circles, incised lines, ring feet ceramics
	Early Formative			1000 to 500 B.C.	jar burial, exotic materials, proliferation of ceramic styles
Iron Age	Middle Formative	Early Iron Age (400 B.C. to A.D. 200)		500 B.C. to A.D. 100	iron artifacts
	Late Formative		Solamillo phase (A.D. 1 to 500)	A.D. 100 to 500	hiatus, southeast Asian trade shifts to west
	Early Emergent Filipino	Early late Iron Age (10th to 12th century A.D.)	Aguilar phase (A.D. 500 to 1000)	A.D. 500 to 1000	river mouth settlements in Luzon, Mindanao, inhumation burials, metal working, weaving, fishing
Porcelain Age	Late Established Filipino	Early late Iron Age (13th to 14th century A.D.)	Santiago phase (A.D. 1100 to 1400), Tanjay as coastal center	A.D. 1000 to 1521	Sung to late Ming ceramics, red-slipped pottery persists with degradation of design motifs, burial jars
		Late Iron Age (13th to 15th century A.D.)			late Yuan, early Ming, Southeast Asian porcelain exports
			Osmena phase (A.D. 1400 to 1600), centralized production, chiefly centers		
	Spanish		Historic phase	1521 to 1898	Qing ceramics, European introductions
	American			1898 to 1946	

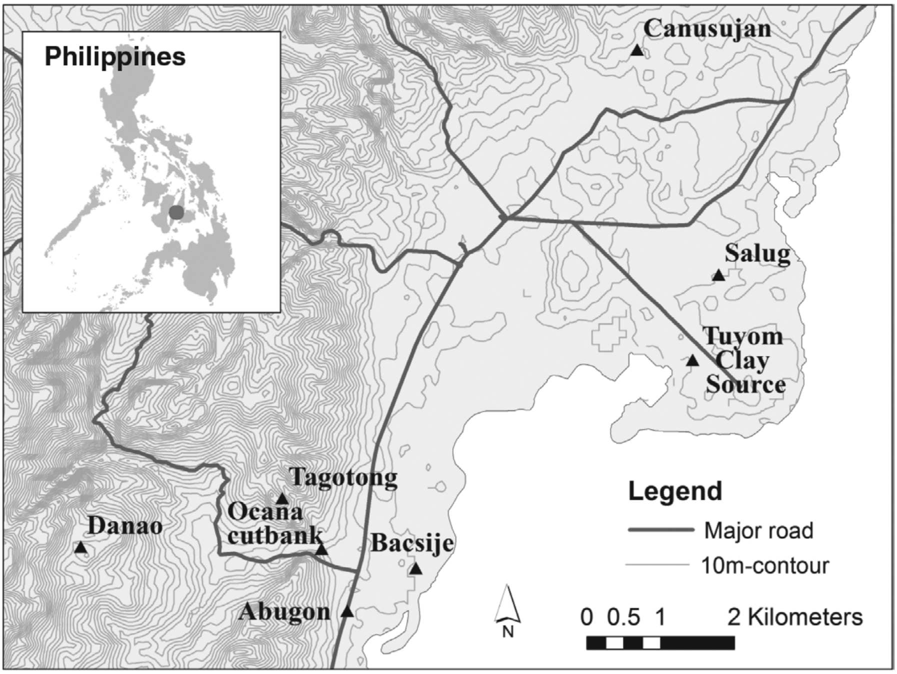


Fig. 1. Carcar archaeological sites discussed in article (map by Virginia Canoy Peterson).

seriously degraded or overburdened with post-settlement deposition, as much as 2–3 m in some alluvial settings. Landscape archaeology in the present article is an effort to rediscover and restore an interpretive framework to this altered terrain. Identifying the ages of landforms, such as buried soils and sites or degraded terrain on ridgetops and in downcut exposures in alluvial terraces, reveals a mosaic of localities coeval with various periods of human settlement. These discoveries form the basic text for a landscape narrative of Cebu that interpolates both historical and ecological change.

The island of Cebu in the Central Philippines is located on a volcanic arc; it has been subjected to variable uplift and subsidence from tectonism. Cebu is arched in the central portion, near the municipality of Carcar, and so was uplifted variously during the Plio-Pleistocene geological period. Sea level rose and fell throughout this period, within a range of 130 m lower to as much as 60 m higher than today. Though Cebu was relatively stable throughout the Holocene, there has been significant uplift throughout the last 300,000 years. As a result, there is a series of nine limestone benches that stairstep upward nearly 300 m toward the central cordillera of Cebu that runs the full length of the island from north to south (Scholz 1986). Likewise, there is a stairstep of ancient coral reef benches downward from present sea level into deep submarine trenches on either side of the island. This complex interplay between uplift and rising and falling sea level created a geological mosaic of varying age from the depth of the marine trench to the top of the cordillera.

Lack of discovery contributes to fuzzy definitions for the periods, since there is too little consistent data from same-age sites to propose definitive ceramic chronologies or consider other artifact classes such as iron tools. Human settlement in the Philippines is known to be as old as 66,000 years ago at Callao Cave in Luzon (Mijares et al. 2010). More recent archaeological sites document a florescence of settlement in the Iron Age (A.D. 500–1500) and the post-contact era (1521–present) throughout the Philippines. The Palaeolithic is known from scant data consisting of expedient lithic tools and a few human burials. Neolithic Age settlement is poorly known, but where well documented it extends from only about 5000 to 2000 years ago. There has been extensive excavation of shell den sites in the alluvial terraces of the Cagayan Valley in northern Luzon (Hung et al. 2011), but otherwise little discovery and documentation of Neolithic sites except for what would likely have been at the end of the period, at least as compared with chronologies reported from Mainland Southeast Asia, which begin about 5000 years ago (Higham and Higham 2009). The Neolithic age, following Beyer, is associated with smoothed basalt adzes and cord-marked or incised pottery design styles, and an absence of iron artifacts. The Philippines likely never went through an independent Iron Age similar to that of the Mediterranean or Middle East. The earliest iron appeared perhaps in A.D. 500, so was most likely brought in from Srivijayan traders; later iron was probably brought through the Moro trade in the region beginning in the late thirteenth century A.D. There is no undisputed evidence for pre-Spanish-contact iron smelting in the Philippines.

An emerging literature of extensive landscape archaeology projects in the Philippines and Mainland Southeast Asia has contributed to settlement models, palaeoenvironmental studies, and site discovery (Acabado 2009, 2010, 2012; Barton et al. 2013; Green 2010; Junker 1999; Kealhofer 2003; Paz 2005; Tiauzon 2009). Earlier work by Solheim (2002, 2006) contributed broadly to the chronology of Island Southeast Asia, but it was from an era when radiocarbon and other absolute dating was not routinely done. There have been significant advances in the application of chronological techniques. Some recent contributions from Mainland Southeast Asia have refined the chronostratigraphic sequence for coastal Southeast Asia (Higham and Higham 2009). Despite survey and excavation projects from particular periods throughout the Philippines, there is not yet a systematic chronology, and there is likely also considerable intraregional variability ranging throughout the Philippine archipelago.

Given these problems, there is a clear need for systematic terrain analyses in order to develop a chronology of landforms and stratigraphic units in the landscape. By working routinely on one research locality and focusing on emerging data sources such as alluvial cutbank exposures and construction excavations, in addition to gradually expanding walkabout survey coverage, one hopes to piece together knowledge about the fragmented, mosaic archaeological landscape of the archipelago.

THE SALUG OR SIALO PALAEOSOL

Rumors of the location of the first parish in Carcar, Cebu, led to an excavation that discovered the cobbled floor and thick limestone walls of the early 1599 church of St. Catherine, which had burned to the ground during a Moro raid c. 1622. A time capsule of artifacts was recovered from the floor assemblage of the church (Peterson et al. 2005). The intensity of the fire calcined the limestone rocks and plaster; the melted walls filled alcoves and sealed lower deposits throughout most of the church.

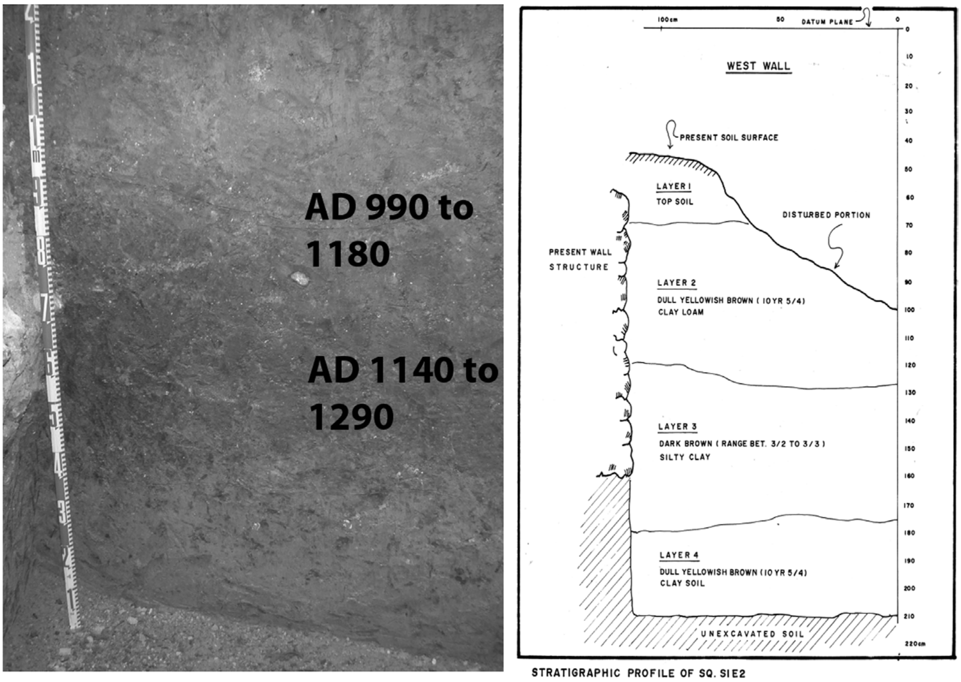


Fig. 2. Salug profile, showing palaeosol at base of cathedral constructed c. 1599.

However, in one area in a 2.0 m deep excavation unit adjacent to the exterior wall of the church, the foundation was found to have been built into a well-developed palaeosol (Fig. 2). The palaeosol extended east and south from the area of the church, and was exposed at ground surface in several locations within a kilometer from the church in the Tuyom barrio.

In one such area, the fine homogeneous clay is mined even today as a source of clay for pottery makers. One shop located in the barrio of Abugon, nearly 7 km to the south, uses this Tuyom clay source for market pottery. It was also used in pre-Spanish times, as documented in a clay source study that found that most of the floor assemblage pottery in St. Catherine's parish was derived from extra-local clay sources, a strong argument against the extent and success of the Spanish practice of *reducción* that brought villagers together.[1] Spanish historical sources indicated that it was not successful during this early period of church history in keeping the parishioners at the parish; likely they retreated to their home villages when not forced to stay for services at the church. The clay was also not a source for the pottery found at a Neolithic site near Ocana, the Aleonar site, which is noteworthy as the palaeosol and its rich argillaceous clay in the Bt horizon likely had not formed until c. A.D. 1000 to 1200. Other pottery from nearby sites during the period from A.D. 1300 to 1500 did match the elemental signature of the Tuyom clay source, as did some sherds from across the Bohol Strait (Peterson et al. 2012).

The palaeosol not only contributed constraining ages to the subsurface terrain in the Tuyom area (cal A.D. 990 to 1180 [Beta 172347] for the lower part of the unit; cal

TABLE 2. RADIOCARBON AGES DISCUSSED IN NARRATIVE FOR CENTRAL CEBU, PHILIPPINES

SITE	SAMPLE NO.		CAL RADIOCARBON AGE
Salug	Beta 172347	palaeosol	A.D. 990–1180
Salug	Beta 172346	palaeosol	A.D. 1140–1290
Ocana Cutbank	Beta 285616	palaeosol—90–1.5 cm bgs	A.D. 390–560
Ocana Cutbank	Beta 285617	palaeosol—180–210 cm	360–290 B.C.
Ocana Cutbank	Beta 285618	palaeosol—300–330 cm	2000–1980 B.C.
Ocana Cutbank	Beta 285619	palaeosol—350–370 cm	1200–930 B.C.
Ocana Cutbank	Beta 285620	palaeosol—420–450 cm	A.D. 50–130
Bacsije	WK 133391	palaeosol—upper unit	A.D. 1185–1285
Bacsije	WK 14490	palaeosol—lower unit	A.D. 1030–1220
Bacsije	Beta 285610	soil near tamaraw	A.D. 1200–1280
Bacsije	Beta 285611	tamaraw—charcoal	A.D. 1170–1280
Bacsije	Beta 296305	posthole	A.D. 1290–1400
Bacsije	Beta 296307	surrounding posthole	A.D. 900–920
Bacsije	Beta 296309	palaeosol	A.D. 30–140
Bacsije	Beta 296 306	charcoal	A.D. 1160–1260
Aleonar Site	Beta 204045	marine shell	400–190 B.C.
Aleonar Site	Beta 204044	marine shell	490–40 B.C.
San Remigio	Beta 303363	palaeosol	A.D. 1450–1540
San Remigio	Beta 303364	palaeosol	modern
San Remigio	Beta 303365	beach rock	1860–1520 B.C.
San Remigio	Beta 303366	coral tip	160 B.C.–A.D. 80
Marigondon	Beta 303358	marine shell	A.D. 1470–1580
Marigondon	Beta 303359	Benthic Marine	1530–1430 B.C.
Marigondon	Beta 303360	Benthic Marine	A.D. 570–650
Marigondon	Beta 303361	Benthic Marine	800–760 B.C.
Marigondon	Beta 303362	sclerosponge	A.D. 160–420

A.D. 1050 to 1100 and cal A.D. 1140 to 1290 [Beta 172346] for the upper part of the unit) but also palaeoenvironmental data. The $^{12}C/^{13}C$ isotope ratio is a relatively high number, indicating that the source of organic carbon that was dated from bulk carbon in the deposit was from plants with ^{3}C metabolic pathways, likely from a forested habitat. To date no archaeological materials associated with the palaeosol have been found, but it provides an environmental chronological marker for the Carcar region, indicating a period of relative stability with active pedogenesis and high biological productivity. Table 2 summarizes radiocarbon ages for central Cebu, Philippines.

BACSIJE AND RIVERBANK EXPOSURES

Bacsije is a barrio about 6 kilometers from the site of Salug and a few kilometers south of Carcar along the coast. A modern, down-cutting channel of the Ocana River exposed palaeosols around 300 m, 1 to 2 m higher than present mean sea level (Peterson 2005*a*). The soils were characterized as tropaquepts and were buried under 1.5 to 2.0+ m of fine massive alluvium with lenses of stable soil formation that suggested multiple episodes of burial and surface exposure (Fig. 3). The higher terrace is 80 cm, 321 m from the shoreline and 80 cm higher in elevation than the second, which is 37 m closer to the shoreline. The higher terrace is 3.1 m above sea level, while the lower is 2.3 m above sea level. The similarity in radiocarbon ages of the two units, cal A.D.

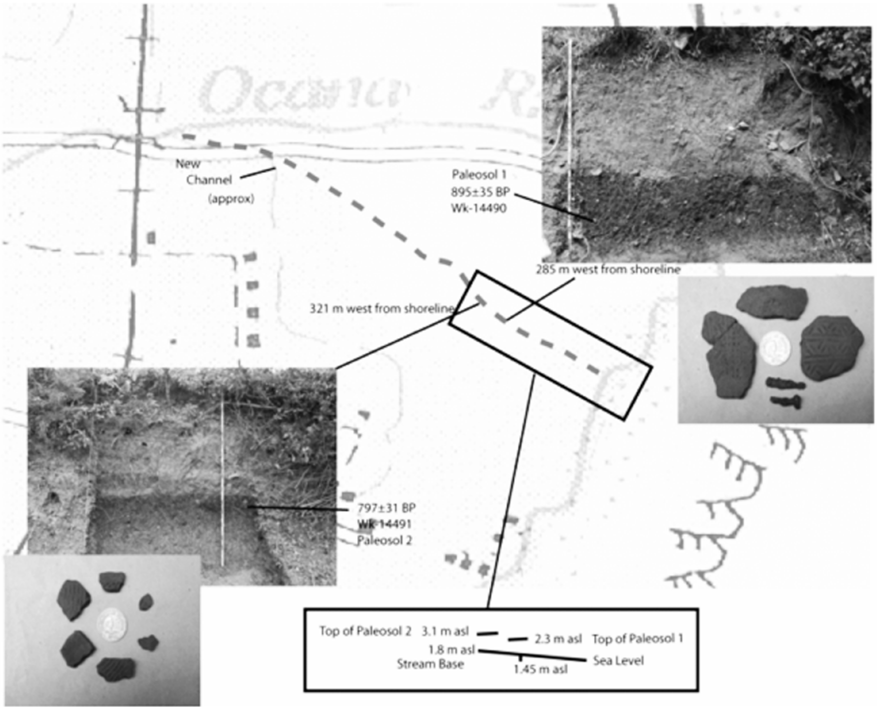


Fig. 3. Bacsije profile, showing elevations and distance from shoreline for cutbank exposures.

1185 to 1285 (WK 133391) and cal A.D. 1030 to 1220 (WK 14490) for the lower, both calibrations at 95.4 percent probability, suggested possible effects of relatively higher sea levels during two different periods (1.8 m higher in the period from 6000 to as late as 2000 B.P.; possibly 1.0 m higher in the period 800–1000 B.P. during the Little Climatic Optimum). The similar radiocarbon ages, however, precluded this interpretation with present data. Furthermore, pollen and phytolith studies indicated that both terraces were part of a mangrove habitat with *Rhizophora* pollen, nearby cultigens contributing pollen and phytoliths. Evidence of disturbance comes from sugar cane, coconut, and *Colocasia* taro found in the higher terrace along with cheno-ams, *Trema* (spp.), and *Poaceae*. This mosaic, geomorphic environment appears to have preserved terraces from the same period of time at different elevations, perhaps purposefully terraced like the present landscape of rice paddies along the coasts of Cebu. Benthic marine shell such as *Strombus* spp., *Murex*, and *Tridacna* shell were densely deposited in the lower portions of the units, suggesting that they had been discarded after harvesting, possibly from the deck of bamboo stilt-houses similar to current *balay* structures that dot the mangrove marshes along the shore.

The pottery from this site consisted of earthenware with cord-marked decorations, notched rims, and circle stamping (Fig. 4). These design motifs can be found in assemblages from both the late Neolithic period and putative Iron Age sites of the region.

Subsequent excavations at the Bacsije site corroborated the age and character of the site (Cuevas et al. 2010). Radiocarbon ages of stable palaeosol exposures were in

Fig. 4. Punctate and cord-marked sherds from Bacsije site, c. A.D. 1000 to 1200, Iron Age period.

the range of 1000–800 B.P., consistent with the Little Climatic Optimum. A similar artifact assemblage was discovered, with incised, impressed, and often slipped surface treatment on earthenware pottery. Numerous net sinkers were found, many benthic marine shells, portions of a burial, and the skeletal remains of a bovid identified as an extinct species of tamaraw, *Bubalis* sp. (Cuevas et al. 2010). The radiocarbon age of the deposit surrounding the tamaraw specimen was found to be cal A.D. 1170 to 1280 (95.4 percent probability) (Beta 285611) from soil associated with the bovid, and cal A.D. 1200 to 1280 from charcoal near the bovid, indicating the latest specimen of native *Bubalis* yet reported in the Philippines.

A posthole dating from the period cal A.D. 1290 to 1400 (95.4 percent probability) (Beta 29635), intrusive into deposits dating cal A.D. 900 to 920 (95.4 percent probability) (Beta 296307), demonstrated the integrity of the chronostratigraphy and also at least two components of occupation for the site.

A radiocarbon age from a unit nearer the current shore and about 130–150 cm below the current ground surface in a "very dark gray silty clay" that overlies a "brown … beach sand or sand" was found to be cal A.D. 30–140 (95.4 percent probability) (Beta 296309) (Cuevas et al. 2010 : 207). This indicates that there are late Neolithic/ early Iron Age deposits in the palaeosol still preserved in the alluvial terraces of the Ocana River. No artifacts were found in association with the palaeosol. The palaeosol, situated just above the high still-stand sea level from 6000 to 3500 years ago, accumulated following the drawdown from 3500 to present (Peterson and Carson 2009). This excavation unit was described as "continuously flooding" with fine to coarse sand interwoven in the deposit (Cuevas et al. 2010 : 207). This demonstrates the elusive character of these relict palaeosols and the serendipitous character of their discovery.

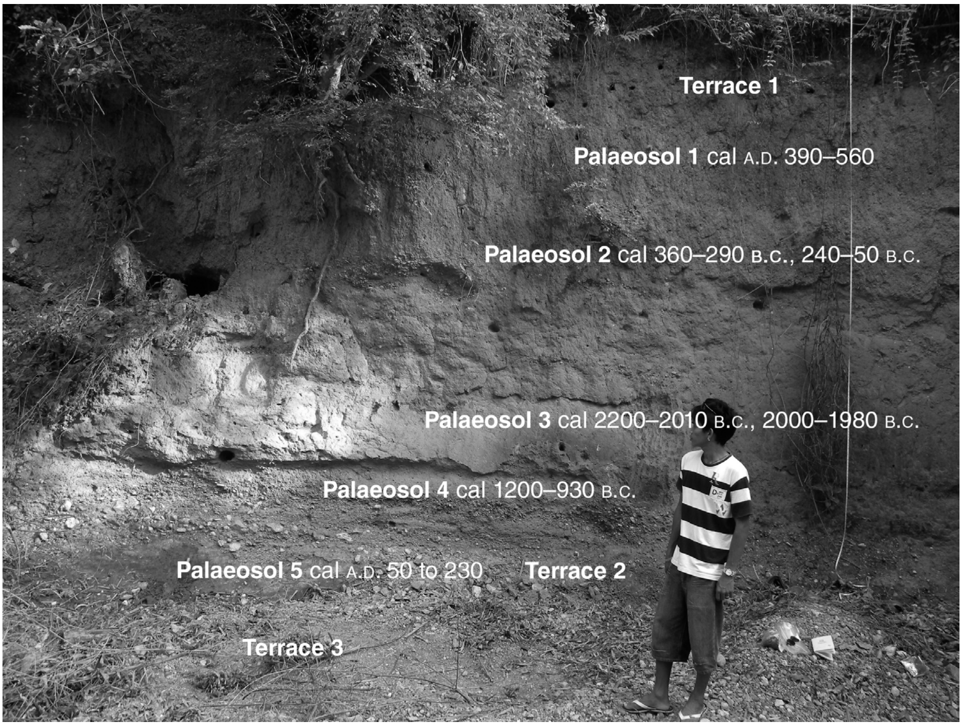


Fig. 5. Ocana cemetery cutbank at top of coastal plain below Ocana valley outlet.

OCANA CEMETERY CUTBANK

Another cutbank exposure 1.5 km inland from the coast is at the narrow outlet from the Ocana Valley where the Ocana River breaks through a narrow gorge with ridges 50–60 m on either side (Fig. 5). The highest elevation of the coastal plain, 30 m above sea level, is just below the break from the valley. Cutbanks there have been incised as deeply as 4.5 m, exposing five separate palaeosols. The highest, 90–150 cm below ground surface (bgs), has an age of cal A.D. 390–560 (95.4 percent probability) (Beta 285616). The next lower, 180–210 cm bgs, has an age of cal 360–290 B.C. or 240–50 B.C. (95.4 percent probability) (Beta 285617). Palaeosol 3, 300–330 cm bgs, has an age of cal 2200–2010 B.C. or 2000–1980 B.C. (95.4 percent probability) (Beta 285618). These three palaeosols are superposed stratigraphically and each is a cumulic palaeosol with an incipient A horizon but weak soil development. Although no artifacts were found associated with these palaeosols, they nonetheless demonstrate that the range of deposits congruent with the Middle to Late Neolithic and Iron Age are buried beneath at least 1 m of colluvium or overbank deposits, with the earliest deposits over 3 m below present ground surface.

A second terrace, Terrace 2, infilled a previous downcut, and a stable surface formed cal 1200 and 930 B.C. (95.4 percent probability) (Beta 285619). Finally, a third terrace, Terrace 3, infilled a downcut channel and formed as a palaeosol during the period cal A.D. 50–230 (95.4 percent probability) (Beta 285620). This latest depositional unit was 420–450 cm bgs.

The exposure shows considerable complexity with cutting and filling sequences as well as strata with different energy-level flooding, represented by clasts ranging from pebble to cobble size overlying the palaeosol units unconformably. Colluvial deposits also accumulated, overlying the periodic pedogenic surfaces.

Much of the near-surface overburden can be traced to the period around 1860, when Cebu was opened to world trade and sugar cane plantations flourished on the coastal plains (Mojares 1985). Wernstedt and Spencer (1967) document over 2 m of deposition attributed to plantation erosion. Earlier disturbances, such as presumed periods of intensification from upland swidden farming, may have periodically increased the sediment load and contributed to the overburden above older surfaces. Finally, much of the alternation between periods of stable pedogenesis and degradation may be attributable to climate change. For example, coring data from an unusually fine-grained Holocene chronostratigraphic record at Huguangyan Maar Lake in South China show considerable variability (Liu and Feng 2012; Yancheva et al. 2007).

Periods of high titanium concentrations are contrasted with low concentrations. The titanium dust blown in from North China during periods of winter drought indicates that condition existed in continental East Asia. However, this is anticorrelated to equable periods of summer monsoons in South China, Mainland Southeast Asia, and Island Southeast Asia. The expansion of the Western Pacific Warm Pool during these periods contributes relatively high rainfall and more equable climate. The periods of high titanium concentration compare favorably with periods of palaeosol formation in Cebu.

THE NEOLITHIC RIDGELINE AND THE ALEONAR SITE

The Aleonar site is situated on the heights of the frontal range above the coastal plain and is 60 m higher than the Ocana Cemetery cutbank site. Two separate samples of marine shell from the site suggest it is a Neolithic age site, dating to the period 400 to 190 B.C. (Beta 204045) and cal 490 to 40 B.C. (Beta 204044). The site had been reported by an amateur archaeologist and subsequently recorded and excavated by Tenazas (1977, 1978). Tenazas noted the odd character of the site, where a very limited artifact assemblage was found, but an infant burial and considerable marine shell were discovered. Peterson (2005*b*) refound the Aleonar site and conducted additional excavation in previously undisturbed deposits, concluding that the site was a ritual-use site based on the ubiquity of small jar sherds, an infant pig jaw, and decorated pottery that reflected the specialized use of the site similar to rituals documented in the ethnographic literature (Cole 1913) and from recent observations among the Subanon in the Zamboanga Peninsula of Mindanao (Peterson 2005*b*). Earthenware pottery decorated with incised diagonal lines around the neck and punctate pottery with chevron designs were found among the mostly undecorated jar sherds (Fig. 6). The radiocarbon ages from the site provide a useful chronological frame for the pottery styles. The site also indicates occupancy of the region during this period, c. 2000 B.P., when same-age landforms were developing both immediately below the site along the Ocana River and also near the modern shoreline in what may have then been a shoreline context, as indicated by the 2000 B.P. era date from a palaeosol immediately overlying a fine to coarse sandy deposit, likely a relict of the 2000 B.P. shoreline.

Tenazas and the amateur archaeologist surveyed the entirety of the ridgelines around Tagotong Hill and reported numerous areas where they found lithic debris and

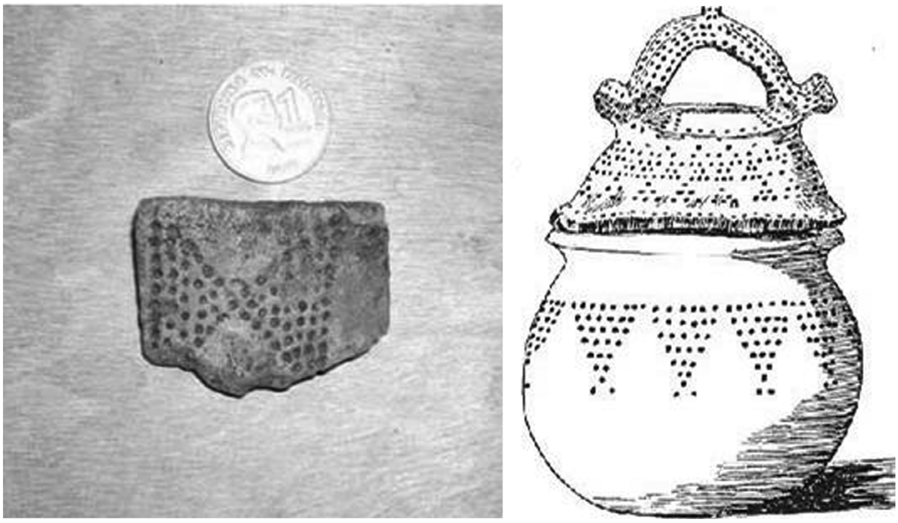


Fig. 6. Sherd with punctate chevron design from Neolithic period Aleonar site, Carcar (left), and puncate decoration on Bagobo cooking pot (right) (from Cole 1913 : 131).

even stone adzes. The site of Tighib, a place-name that translates as "chisel" or "adze," was located on an exposed ridge across the Ocana River from Tagotong. Finding prehistoric artifacts on the ridge suggests that local residents made a connection between the ancient and modern settlements.

The marine shell noted by Tenazas, and that filled many collection boxes at the University of San Carlos in Cebu City, was in many cases not from the contemporary sea along the shore of Cebu. Tectonic uplift and successive periods of climate change and high still-stands going back into the Pleistocene formed these terraces, often hundreds of thousands of years ago. The terrace that forms the ridge heights of Tagotong and Tighib has a U/Th age of 400,000 B.P. (Scholz 1986).

DANAO SITES

Sinkholes known as *danao* are dispersed throughout the karstic terrain of Cebu and are often associated with archaeological sites. These features range from a few to several hectares in diameter. They are often farmed, as they are generally fertile and arable when not waterlogged. In Argao, above the Argao River, two large artifact scatters with black and white pottery as well as earthenware were found on low ridges above a *danao*. Characterized by a surface artifact scatter, they appear to be village sites. In the Carcar area, uphill from Ocana and Tagotong, a *danao* has been found with sites above the upper shoreline that have earthenware and black and white ceramics. These features were probably small lakes during the early Holocene and may have been filled during wet periods, such as c. 1000 years ago during the Little Climatic Optimum. They are dispersed throughout the upper elevations of Cebu where they would have benefited from rain shadow effects during periods of equable southwest monsoons. They might therefore have been attractive high elevation localities during periods recorded in the palaeosol exposures, such as at the Ocana Cemetery cutbank.

Fig. 7. Magsuhot site, Negros Oriental, showing piedmont terrain.

HILLSLOPE SITES

The Magsuhot site, in Negros Oriental near Dumaguete, was found on the broad hillslopes, or piedmont terrain, between the base of interior mountains and the coast (Fig. 7). The slopes in Negros have fertile soil and are well watered. They are dissected by a network of small spring-fed streams that coalesce into secondary drainages that flow to the sea. The Magsuhot site is distinguished by its elaborate and elegant funerary pottery (Kalanay Style) from the early Iron Age (Mascuñana 1986; Tenazas 1974). This clear horizon marker in Visayan archaeology was first described by Solheim (2002). It is mostly found in caves and rockshelters, much as Solheim first found it during his boat survey of the southern Philippines.

The site of Canasujan, north of Carcar, was found during a reconnaissance survey. The site is exposed at the ground surface because pottery has been stirred upward by plowing. It consists of a scatter of artifacts similar in style to Magsuhot pottery (Fig. 8). It is dispersed over a 2–3 ha agricultural field. This early Iron Age site is included here, despite lack of intensive survey, documentation, or radiocarbon data for the period, to illustrate a period of occupation that might be found elsewhere in similar terrain and that might contribute data for one of the lesser-known periods in the regional chronology.

SHORELINE SITES AND INLAND TERRAIN

The most ubiquitous and obvious sites that have been reported on Cebu are those along the shoreline, especially near drainages. The modern land surface has been sufficiently stable over the past 600 years that sites from the Porcelain Age are well preserved and very obvious. Asian porcelain pottery serves as a useful chronological marker for these sites. Some appear to have been occupied continuously from as early as late Song or at least Yuan dynasties, c. A.D. 1200–1400. They are usually mixed with earthenware pottery and other artifact types, including netsinkers and ground stone tools. Most sites have posthole features indicating stilt-house *balay* structures. The thousands of stilt-houses reported by the early Spanish, as they sailed along the coasts of Cebu, were undoubtedly similar to those from only a few centuries earlier. The density of structures appears to have misled the Spanish into thinking

Fig. 8. Magsuhot-type pottery from Canasujan site, Carcar.

that the shoreline sites were major settlements. However, the dispersed scatters and individual artifacts—located throughout the lower front range, along river valleys, and in high terrain around drainages and *danao*—are frustrating to find and document, as they do not appear to be concentrated or associated with features. Centuries of agricultural use and sheet deposition have severely disturbed the surface terrain.

The distribution of artifact scatters and other sites in the interior has not been comprehensively documented, but it would be presumptuous to assume (as early Spanish colonists did) that the thin veneer of coastal sites was the dominant settlement node in the region. There is an edge effect where the concentration of artifact assemblages and small villages may be more visible than the disaggregated settlement inland that is dispersed over a very large area. The land area is so much greater inland, with numerous niches such as along drainages, on hillslopes, and around *danao*, that it may actually have hosted a larger population than the coast. Further complicating this comparison are ethnographic accounts documenting short-term transhumance from highland to coastal sites, sometimes for weekly fishing trips, or, in more recent times, for fishing and church attendance on weekends (Seki 2000). Multiple homesites were maintained around interior farm fields as well as along the coastline. The greater density of Porcelain Age deposits on the surface suggests higher population density during more recent periods, but this is also not clear, as there has been no systematic study of the chronostratigraphy of these sites. Generally, burial areas have been extensively excavated, but there has been little survey of surrounding terrain or deeper deposits.

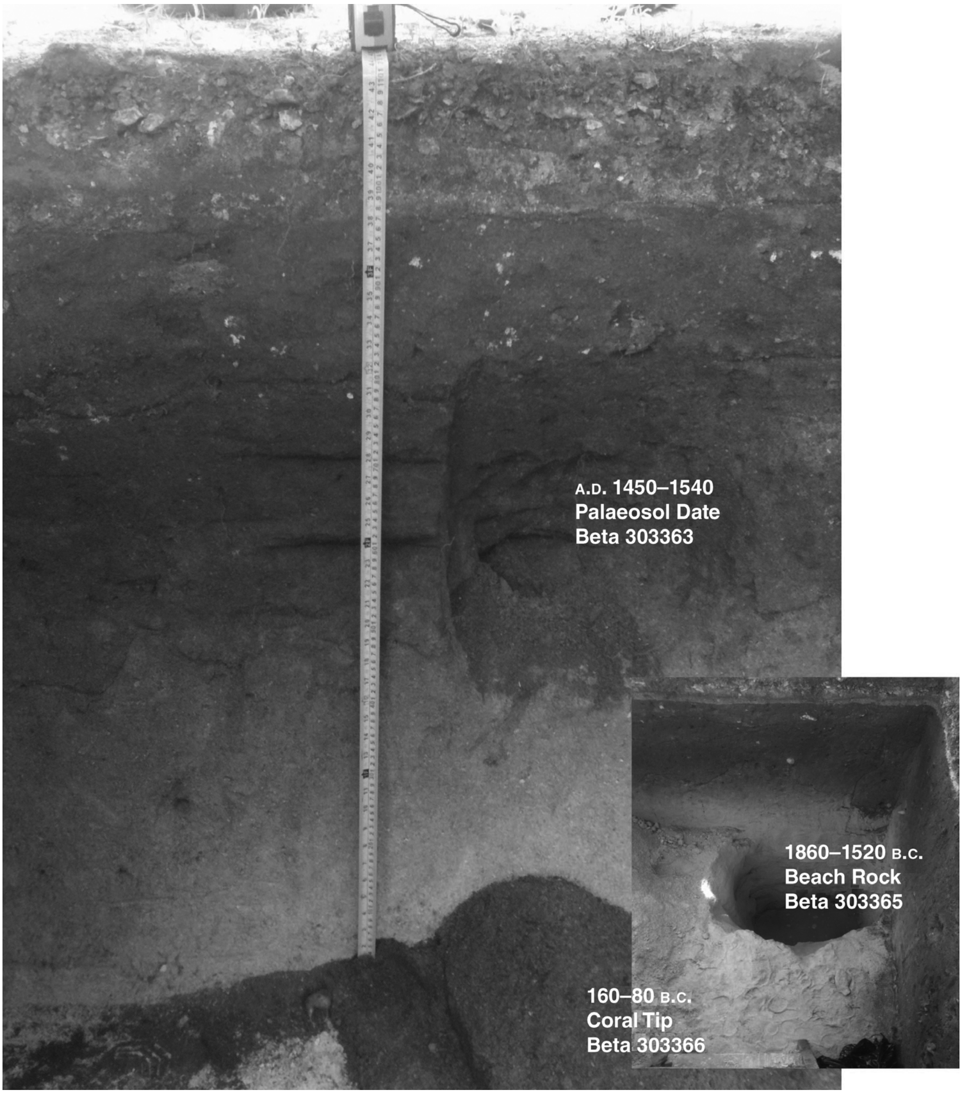


Fig. 9. San Remigio profile showing radiocarbon ages relative to subsidence.

Another phenomenon affecting shoreline sites throughout the Philippines is local subsidence or uplift from tectonic forces (Berdin et al. 2000; Siringan et al. 2000). Sites in the center of Cebu appear to have been subjected to uplift as recently as 300,000 years ago, but are currently stable (Scholz 1986). However, localities in Bohol (Berdin et al. 2000) and San Remigio may have subsided as much as 2 m below current sea level elevations. Ages of an anthropic A Horizon, or palaeosol, exposed in excavation units in San Remigio are very recent for the depth of exposure (Fig. 9). Beach rock found at 180 cm bgs has a radiocarbon age of cal 1860 to 1520 B.C. (95.4 percent probability) (Beta 303365). This is nearly 1 m above the present sea level, suggesting that the shoreline c. 2000 B.P. was at 1 m above present sea level, but has subsided at least a meter since then. The A Horizon formed as a dense soil over massive sand that accumulated from dune formation above the prograding sea level from its 2000 B.P. still-stand. It presumably dropped another meter from the Holocene 1.8-m-high still-stand during the period from 6000 to 4000 B.P. (Peterson and Carson 2009). Observations of current sea level show that at high tide the tops of wave-cut notches are submerged. This suggests very recent and dramatic subsidence. Other areas such as Laguna de Bay and the Manila battery are shrinking from development and withdrawal of freshwater from coastal aquifers.

CAVES AND ROCKSHELTERS

Many of the sites that have produced Kalanay pottery, mostly as burial objects, have been rockshelters. This, along with rumors of Yamashita's gold, led to wholesale ransacking of deposits in caves and rockshelters throughout the Philippines.[2] A very large cave near Mangyan (above Ocana) was excavated to a depth of 10 m by guano hunters. Some of the caves still have piles of rubble from broken Kalanay burial jars on the talus below the mouth of the cave.

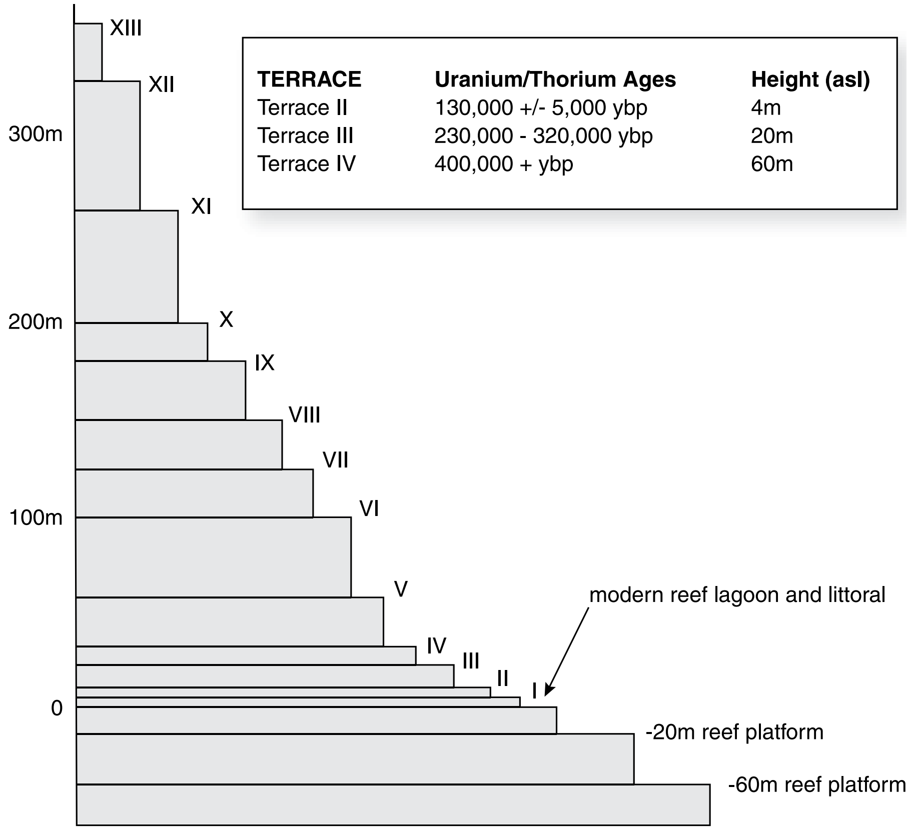
Marigondon Cave, offshore from the Plantation Bay Resort on Mactan Island in Cebu, was explored in order to evaluate the landscape history of marine terrace formations and the likelihood of finding the remains of prior human settlement in the cave. The cave has been a favorite recreational diving site for several decades. The former floor was 40 m below surface, in front of a long tube that divides into two chambers that extend about 130 m toward the shore and rise to within 24 m below surface toward the rear of the cave (Cusi et al. 1993; Scholz 1986) (Fig. 10).

Marigondon is a classic flank margin cave that would have formed above sea level within a fossil coral reef platform that formed underwater probably between 40,000 and 80,000 years ago. The cave was subaerial again following the last full glacial period 22,000 years ago, at which time the sea level was approximately 130 m below present sea level. By 12,000 to 15,000 years ago, the cave was submerged again as sea level rose to modern levels. During the period 15,000 to 40,000 years ago, and again possibly 50,000 years ago, the cave would have been above sea level and could have been settled by humans during that period. The earliest evidence for human settlement is c. 66,000 years ago at Callao Cave in northern Luzon (Mijares et al. 2010).

Chronostratigraphic investigations of the floor of the upper antechamber within the entrance to the cave indicate that the sediment down to about 50 cm was deposited within the last few thousand years. Therefore any potential terrigenous or subaerial deposition, including human occupation, is still unexposed in the floor of the cave.

Numerous submarine flank margin caves are dispersed throughout the Philippines. Some may have potential for discovery of human occupation during the period from 40,000–50,000 years ago up until 12,000–15,000 years ago. Most should have been isolated from the impact of treasure hunting for artifacts and Yamashita's gold. However, nets, possibly employed to shore up the lower floor deposits in the cave, were found in the 2011 expedition to the cave; these could have been left by treasure hunters. Nonetheless, the upper anteroom deposits appear to still be intact.

A specimen from the fossil coral reef platform with a mantle of travertine was recovered from the rear of the cave. It is currently slated for U/Th carbonate dating in an attempt to establish the period of formation and the period of subaerial emergence when travertine could have formed as flowstone over the fossil coral in the interior of the cave.



TERRACE	Uranium/Thorium Ages	Height (asl)
Terrace II	130,000 +/- 5,000 ybp	4m
Terrace III	230,000 - 320,000 ybp	20m
Terrace IV	400,000 + ybp	60m

Fig. 10. Coral reef terraces (subaerial terraces, dates, and sea level data from Scholz 1986).

HISTORICAL CONTINGENCY

Geological and geomorphological events and processes operate on long- and short-term time scales. They impact human settlement as well as site taphonomy. For example, flank margin caves in the high escarpments near full-glacial period coastlines were attractive settlement localities, much as Tabon Cave has been throughout its long history. Tabon is currently near sea level on the west coast of Palawan, but during its habitation it was 130+ m above sea level. The long Palaeolithic period in the Philippines chronology is marked by chipped stone tools and skeletal assemblages, including human burials.

The first Neolithic period lifeways in the Philippines appear to have been around 4000 to 5000 years ago, during the same period as in Mainland Southeast Asia (Higham 2002; Hung et al. 2011). Changing climate and sea level during this period had profound effects on human settlement of the entire East Asian and Southeast Asian regions. A long period of equable climate before 4000 years ago occasioned emergence of informal as well as formal agricultural practices (Liu and Feng 2012). In less developed regions, dryland farming for millet, yams, and other small grains, as well as wetland farming for taro, supported village level settlement. Before 5000 B.P., rice paddy agriculture was practiced widely in South China. Henan province, the homeland of the Shang state c. 1760 B.C., was a center for proto-state formation prior to that, as early as 5000 B.P., with bronze manufacture and walled archaic cities forming rapidly throughout the region. An expansion of Chinese archaeological work at "large sites" throughout China in the last decade has provided extensive data showing the emergence of state-level polities in walled cities before the historically documented Shang dynasty (Liu 2004; Liu and Chen 2009).

The impact on coastal peoples was profound, since people settling the margin of the sea were already subjected to environmental perturbations in the form of rising sea level. Around 5500 years ago, sea levels rose rapidly to an elevation 1.8 m higher than modern sea level. Rapid change in coastal terrain is anathema to mangrove habitat, so either rising or falling sea level would have degraded and constrained mangrove adjustments toward preferred brackish conditions. Episodically lowering sea levels during the next few thousand years would have contributed equally to mangrove degradation (Berdin et al. 2000). During periods of mangrove retreat, maritime coastal settlers would have been forced to expand their catchment range for local resources such as *gafrarium* and *anadara* shellfish, as well as reef and pelagic fishes, whose populations would decline as their coastal nurseries were diminished.

At the same time, pressure from emergent state-level polities on the mainland of East and South China would have forced coastal peoples from land out to sea. Sea level change and the effects of a powerful sociopolitical formation in the mainland may have combined as historically contingent events to force maritime migration along the coast of South China, Mainland Southeast Asia, and Island Southeast Asia. At least one of the early walled cities likely linked into this emergent state-level formation is the site of Beinan in south Taiwan (Lien and Sung 1986). Though the radiocarbon chronology is not clear for the site, there are dates from human bone as early as 4760 B.P., and the few others reported cluster around 2700 to 3100 B.P. The impetus for "Austronesian" migration might not have been exclusive to Taiwan but common to the coastlines of the entire region as maritime peoples were flushed out into the maritime world of the Philippines and the South China Sea.

Shang-style civilization spread rapidly throughout Mainland China. Recent work shows that outlier polities that were not subservient to the Shang emperor, but very much in the ideological orbit of the Shang, were extensive throughout South China south of the Yangtze (Liu and Chen 2009). The site of Hemudu has long been known to have been a rice-farming community as early as 5000–6000 years ago (Liu 1993). The model of archaic town and state pioneered by the Shang emperor was apparently adapted to rice-farming from the millet base in the north. It no doubt was readily received as part of a package of knowledge, ideology, and power. Robert Suggs first proposed this concept in 1960, but it was dismissed by Bellwood (2004:35) because the age of the Shang dynasty, 1360 B.C., postdated his proposed chronology for the Austronesian migration of 4000 to 5000 B.P. However, the new data from Liu (2004) and others support earlier state formation, walled and archaic cities, and the emergence of bronze and other identifiers of complex society in China.

The emergence of settlements such as Non Nok Tha in Mainland Southeast Asia shows that agricultural techniques were shared and political connections established very early, in the era 4000–5000 years ago (Higham 2002). These were not Austronesian speakers, at least judging from the surviving and modern language communities in that region, and the spread of Austronesian peoples from Taiwan to Luzon did not include the export of either ideas about state formation or the technology or material culture of rice-farming or bronze metallurgy. No bronze objects from the period 3000 to 5000 years ago have been found in the Philippines.

What were the relations, culturally, linguistically, and politically among the "Austronesians" and the powerful archaic and state-level formations dominating settlement on the mainlands of East Asia, South China, and Southeast Asia? James Scott illuminates these relations in his recent work on the history of upland Southeast Asia, *The Art of Not Being Governed* (2009). He provides a powerful theoretical insight into the decentralized, heterarchical, dispersed polities of hinterland and highland Southeast Asia and compares them directly to the lifeways and organization of maritime nomads, characterizing Island Southeast Asia as a maritime hinterland. His comparison is brief and undeveloped, but resonates with other models of maritime nomadism and migration such as Solheim's (2002) model of the Nusantao.

The hill country of Southeast Asia constitutes a new kind of region to Scott that is not based on national boundaries, but rather on disassociation and disconnection from national boundaries. The hill people are the ungoverned rather than the governed, but individuals and groups shift back and forth across these boundaries. Nomadic peoples and states are a dynamic dyad, representing the raw and the cooked or the crude and the refined, linguistically called the "wild" and the "tame" throughout Southeast Asia. In Asia, wet-rice production equates with centralized, governed, settlement that "requires a density of population that is, itself, a key resource for state-making" (Scott 2009 : 41). Likewise, the dispersed fields or forest resources of the hill country promote decentralized, dispersive, low density settlement with informal, low intensity governance. What characterized the hill country of Southeast Asia also typifies the coastal margins of East and Southeast Asia and lifeways dispersed throughout the margins of the sea.

This maritime migration was therefore not an organized phenomenon governed by centralized polities, but was rather a reaction to the development of archaic states and subsequent state expansion throughout East Asia and the Southeast Asian mainland. One form of organization favored small-scale, local, ungoverned, dispersive pods of movement, rapidly adapting to monsoonal seasons and localized opportunities dispersed throughout the margins of a vast network of oceanic edges. By contrast, the Asian state form of organization depended on settled agricultural populations with access to fertile land and abundant freshwater for rice production. Austronesian settlement was distinctly untethered from rice farming or it would have merged into its opposite form of organization.

By 2000 years ago, sites of a later period of Neolithic settlers were scattered on ridges, swales, and saddles in higher terrain throughout the cordillera of central Cebu (Tiauzon 2009). Nonetheless, they likely maintained a settlement node in the mangroves along the coast as demonstrated by the appropriate-aged deposits and by artifacts and features from the Iron Age period.

By the period of renewed contact with the rest of Asia, as early as around A.D. 500, iron objects such as *kris* knives are found in burial sites in the Philippines. A Tang dynasty vessel was found by a farmer in a well excavation near the site of Salug, so there was apparently contact with Chinese traders as early as A.D. 800. By the early fourteenth century Islamic traders were establishing entrepôts in the region, especially in Brunei and Manila. Early Porcelain Age swidden farmers may have increased the sediment load from the uplands, beginning the process of site erosion in the uplands and burial in the lowlands (Nishimura 1992). Spanish colonization forced resettlement in urban centers, though this was probably less successful in outlying areas such as Carcar, where local clay sources were used rather than the high-quality Tuyom clay found near the cathedral in the early seventeenth century. Spanish practices as well as the impact of Moro raiders also transformed coastal settlements and populations. Villagers were organized into militias by priests (Peterson et al. 2012); sometimes entire settlements moved hundreds of kilometers to escape burned-out villages. By the nineteenth century, the opening of Cebu to world trade led to the formation of vast sugar cane plantations that obscured the precontact landscape by burial from upland degradation and farming practices on the coastal plain. These historically contingent changes in the social order, foreign contacts, and local political formations are interleaved with changing environmental conditions from tectonic to eustatic sea level and seasonal, decadal, and millennial climatic conditions.

Until a robust chronology of landforms and archaeology tied to systematic absolute dating strategies is constructed for the region, however, the direct and indirect effects of these emergent social formations cannot be adequately assessed for the region.

SUMMARY AND CONCLUSIONS

An archaeological landscape is often made up of disjunctive, fragmented elements that do not portray the human history of a place. Site discovery and taphonomy are conditional upon environmental conditions and processes including tectonism, climate variability, eustatic sea-level change, and geomorphic processes of degradation and deposition. Finding sites within this patchwork of lenses and interleaved deposits is like following a maze. It is made more complex by human actors who themselves change the conditions of site formation and transformation.

For the landscape of a small universe in central Cebu, in the Visayas region of the Philippines, there are many resources still to examine. Future chance discoveries will perhaps contribute to the large gaps in the present heuristic cultural chronology for the region. Continuing examination of cutbank exposures or construction excavation on the coastal plain may lead to discovery of older intact deposits, such as wetland and upland palaeosols that may have associated archaeological materials. Such discoveries will be constrained by higher sea level during the Holocene high stand of 1.8 m above present sea level within 100–200 meters of the present shoreline, depending on the gradient of the beach. Everything now seaward from that high still-stand will have settlement terrain subsequent to 2000, or 3000, or 4000 years ago, depending on distance from the shore. These are also likely to be buried up to 2 m deep by sugar cane era erosion, but locally unique exposures such as from avulsive river channels or ditch and canal construction may reveal them. Further inland, at the base of the coastal range of lower hills, landforms near where rivers debouche onto the coastal plain may be deeply buried, as deeply as 4 m, but away from the rivers at the base of slopes may have less overburden.

Upland drainages with pockets of alluvial terraces may have buried deposits. Palaeosols with early Porcelain Age artifacts, apparently from the 800 to 1000 B.P. era, are exposed high in the cordillera; older palaeosols may be preserved there as well. The headwaters for rivers such as the Argao River flow for a considerable distance in the high cordillera valley. The area is conducive to site formation and preservation, but has not yet been intensively explored. Discovery of Neolithic sites on ridges in this area is promising for recovery of additional settlement data, at least from the late Neolithic.

Exploration of *danao* in the highlands may also yield long-term settlement data. Coring in the wetland *danao* and excavation above former high still-stand shorelines might yield access to older deposits. The shorelines are aggrading terrain from upslope erosion and redeposition, so the former elevations may be buried. Sites are found in higher terrain above the *danao* from Porcelain Age settlement on the ground surface.

Absolute dating from radiocarbon and other isotopic metrics like uranium-thorium is critical to building a better chronology for the Philippines. Dating of a variety of materials including shell, bulk carbon in soil matrix, foraminifera and coralline algae from lagoonal deposits, and bone, and use of techniques such as Optically Stimulated Luminescence (OSL) should be liberally employed to provide constraining dates within which to interpret human settlement remains (Peterson and Carson 2009).

The mosaic of settlement choices interacts with a matrix of historical environmental changes. Understanding these environmental processes and landforms can illuminate our understanding and knowledge of archaeological landscapes. Human choice and action often contributed to these changes, so each of the two interacting processes illuminates the other. A historical ecology framework for landscape studies in Cebu is contributing the beginning stages of a terrain model that can serve as a map for discovery of occulted archaeological sites as well as change in settlement and subsistence systems. To date, the discoveries have been fragmented and mosaic in character, but some periods of settlement are better known, such as the Porcelain period (in Beyer's chronology) where sites are on or near the surface and highly visible, and constrained chronologically. Even so, upland degradation from abusive farming practices in the last few centuries has destroyed the dispersed evidence for upland settlement during this period; this has led to interpretive bias toward coastal residence. Absence of data in this terrain model thereby contributes to landscape mapping except where it is locally preserved such as in *danao* localities and high cordilleran river valleys. Combining geomorphological and archaeological protocols in field studies in Cebu and the Philippines contributes to a landscape approach that interpolates both cultural and physical data and processes of change. With a more robust human settlement chronology, the direct and indirect impacts of emergent social formations across hundreds of ocean miles, from South China and Mainland Southeast Asia, on Philippine people and polities could be evaluated as part of regional and macroscale phenomena.

NOTES

1. The practice of congregating native people in the Spanish colonial world was enforced both by the mission priests to facilitate conversion to Catholicism and by the *encomenderos* (landowners) to concentrate the labor force.
2. General Tomoyuki Yamashita, the Tiger of Malaysia, was the commanding general of Japanese forces in the Philippines during the occupation that began 8 December 1941. There were ubiquitous rumors that he had hidden Japanese gold just before making a hasty retreat following the U.S. allied invasion in 1945 (Seagrave and Seagrave 2003).

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ABSTRACT

Landscape formation is often discontinuous and punctuated by rapid change, and cultural landscapes may be fragmented and found in chronological and spatial mosaics rather than continuous progressions. Human occupation of the Carcar area of the central Philippines is discussed relative to these effects. Pleistocene evolution of landscapes in Cebu is a complex array of uplifted fossil coral reef platforms that form the lower benches of the central cordillera of the island. These formed during periods of high sea level, and their present altitude has been increased by periodic tectonic uplift. Submarine fossil coral reef platforms are components of this landscape evolution, and at least two at depths of 20 m and 60 m below the present sea level formed in the mid- to late Pleistocene. A submarine flank-margin cave, Marigondon Cave, formed in the 20 m reef platform when subaerial in the period from 80,000–10,000 B.P. More recent Holocene-era sea level change, rising by 1.8 m above present sea level in the period from 2000–6000 B.P., altered coastal terrain and constrained human settlement to the upper extent of the present coastal plain. Subsequent upland degradation has buried the mid-Holocene shoreline below 2–3 m of colluvial deposits. These two contexts for human settlement are situated in the complex mosaic of the present geography of Cebu, with other localized settlement opportunities such as *danao* (sinkholes), caves and rock shelters, shorelines, bajadas, and high cordilleran river valleys. The history of physical processes is interleaved with human history, and the choices and cultural changes that themselves impact the landscape. Keywords: landscape archaeology, Philippines, Southeast Asia, Cebu, geoarchaeology, chronostratigraphy.